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THE CANADIAN RAILWAY CLUB HEARS ADDRESS

"Notes on Heavy Electric Traction," by Mr. J. A. Shaw.

ELEC. ENGINEER, C. P. R.

Remarks Confined Mainly to Chicago, Milwaukee and St. Paul Ry. Electrification.

The Canadian Railway Club listened to a very interesting and highly instructive address on "Notes on Heavy Electric Traction," by Mr. J. A. Shaw, General Electrical Engineer, Canadian Pacific Railway Company, last evening.

Mr. Shaw gave a brief resume of electrification on several of the railways, but confined himself mainly to the Chicago, Milwaukee and St. Paul Railway. Through the courtesy of the General Electric Company, the lecturer was able to supplement his address by three films of pictures of the advance of electrification.

The C. M. and St. P. electrification differs from all previous projects in that it embraces four complete engine divisions as operated by steam locomotives. None of the existing electrifications on trunk line railways, either in this country or in Europe, have included more than one engine division. The electrified portion includes 440 miles of route, embracing 650 miles of track, and includes some of the most serious grades encountered between Chicago and the Coast. Under steam operation 103 locomotives were necessary, and the schedule was with difficulty maintained. The very low temperatures in winter, ranging sometimes as low as 40 or 50 degrees below zero, made it extremely difficult to keep steam locomotives in operation. Under the electrical equipment for this line, but 42 locomotives are required, and the experience so far seems to indicate that this number will be able to cope with all conditions for some time to come. In addition, it is probable that trains will be operated much more nearly on schedule than, and with less damage to equipment owing to accidents.

One of the most completely equipped hydro-electric plants on this system is the Volta plant, in the Great Falls of the Missouri River. This station at present contains four 10,000 k.w. vertical generators. The available head at this point in the Missouri River is 155 feet, and the supply of water is at all times ample. The main line locomotives have a total weight of 232 tons, with nearly 80 per cent. of weight on driving axles. Each locomotive carries eight 420 h.p. motors, each geared to a driving axle with twin gears. The tractive effort available for starting trains is approximately 135,000 pounds at 20 per cent. coefficient of adhesion, and the continuous tractive effort is 71,000 pounds.

One of the most distinctive features of this electrification is the regenerative braking on the locomotives. Two trains descending a grade will generate sufficient current to haul another train of equal tonnage up the same gradient. When braking a train by the regenerative method, there is no overheating, as is the case with air brakes. The brakes will thus always be in good condition when required for emergency. Should there be no train available for absorbing the excess energy the power is taken up by one or more of the substations and returned to the main system, where other uses can be had for it.

One of the pictures showed clearly the superiority of electric locomotives over steam ones. A train of 48 cars weighing 3,000 tons, was hauled up a grade by a 232-ton electric locomotive. The grade was made quite easily, as the speed averaged about 16 miles per hour. Following this train was one of 37 cars, weighing but 2,200 tons, and hauled by two Milwaukee type steam locomotives, and one Mallet steam pusher. Great difficulty was encountered in making the grade, and the speed dropped down to 9 and 10 miles per hour.

In the discussion which followed it was brought out that there were many important and economical reasons why the number of electrifications will continue to increase rapidly, especially in Canada. When asked regarding the probable electrification of the C. P. R. between Montreal and Quebec, the speaker said the physical features offered exceptional inducements in the way of water power, but that the peak load would be very abnormal, due to the unique condition of very heavy traffic after the arrival of ocean boats at the different ports.

Mr. Shaw prophesied that just as the horse car had given way to the street railway, so also would the steam locomotive give way to the "King of the Rails," the electric locomotive.

MAKES GOOD AVIATOR.



LIEUT. "DON" BROPHY.

Formerly of Arts '17, and of the senior McGill football team, who has, according to reports, been making a name for himself as a capable and daring flier overseas.

MAJ. SMYTH APPOINTED CHAPLAIN TO RANGERS

Appointment is Recognition of Fact That all Irish in Canada Are United.

Major the Rev. James Smyth, principal of the Wesleyan Theological College, has been appointed Protestant chaplain to the Duchess of Connaught's Own Irish-Canadian Rangers, and will leave with the battalion when it goes overseas.

The appointment of Major Smyth will give the Rangers two chaplains, as Captain Hingston is the Catholic chaplain at present; and the new appointment is an official recognition of the fact that both the Roman Catholic and Protestant Irishmen in the Dominion have united together to fight the battles of the Empire. It is also felt that when the battalion, which is commanded by Lieut.-Col. H. J. Trihey, visits Ireland, this co-operation will prove of advantage in illustrating the unity of Irishmen in Canada on patriotic questions.

An influential deputation waited on Major Smyth to persuade him to accept the post of chaplain, and his board of governors of the Wesleyan Theological College having given him leave of absence till the beginning of next session, Major Smyth accepted the post.

As chaplain of the 4th and 5th Military Districts, Major Smyth did a great deal of work during the summer and fall on behalf of the soldiers, organizing religious work in hospitals, etc. He has also taken a prominent part in recruiting, and his vigorous speeches, mostly on behalf of the Irish Rangers, have been fruitful. Major Smyth came to Canada nearly five years ago, being a native of Portadown, County Armagh, and having previously been an outstanding figure at Irish ministerial conferences. He is a member of the Protestant School Commission, and also of the Montreal Protestant Ministerial Association, which body at its meeting yesterday passed a resolution of congratulation on his appointment.

LIEUT. IRWIN RETURNS.

Lieut. W. Eric C. Irwin, Sci. '11, who went overseas as one of the officers of the First Universities Company, P.P.C.L.L., and who was seriously wounded last summer, has now returned to his home in Ottawa, on extended sick leave. Lieut. Irwin was one of the first of the officers of the McGill C.O.T.C. to volunteer when the organization of the First Universities Company was started.

The University of California received a gift of a collection of Indian baskets. The collection formerly belonged to E. L. McLeod. It contains 220 specimens, chiefly baskets from California, but also from Alaska, British Columbia, and New Mexico. The most valuable baskets in the collection are those made by the Shoshonean tribes in the vicinity of Kern River, California.

HOW CALLANT STUDENT DIED RALLYING MEN

Sergt. Louis Robertson Was a Very Popular N. C. O.

FELLOW-SOLDIER WRITES.

Lieut. Donald Maclean, Arts '16, Warm in Praise of Qualities of Dead Soldier.

A warm appreciation of the late Sergeant J. Louis A. Robertson, Arch. '15, killed in action in July last, is contained in a letter received yesterday morning by McGill Daily from Lieut. Donald Maclean, past student with Arts '16, and now with the Princess Patricia's Canadian Light Infantry. A strange co-incidence is found in the fact that Lieut. Maclean was himself reported wounded in yesterday morning's casualty list.

Lieut. Maclean writes from the trenches under date of November 25 as follows:

"I have just been reading your paper of October 3rd, and I would like to tell you a little about Sergeant J. L. A. Robertson, who was mentioned among those killed in Flanders. "He and I were sergeants together for ten months, and I learned to like him more than any friend I have ever had. I have never known anyone more unselfish or so generous in his opinions of others. This won for him a great many friends in the Regiment, especially among the 'old-timers,' who were more or less given to calling us 'McGills' (a name which in the early days meant a sort of jam-eating soldier), and to thinking we would not be ready to chum up with the real old soldiers. Robertson's friendship for all those boys was so great that he did not wish to take a commission in the battalion when it was offered to him, because he feared that as an officer he could not mix with the men in the most friendly and unreserved manner.

"After we were acknowledged as fine fellows by the veterans of the second battle of Ypres, we felt that a high hill had been climbed, and we were getting nearer to the place where we would be one with 'the originals,' but still we had to show our fighting qualities in battle in order to prove our right to share in the honors of our famous regiment. The opportunity came in June, and after the fighting I heard an old sergeant say in most emphatic tones, 'Whoever says the McGill boys are not great soldiers is no friend of mine, for the old-timers never fought so well.' I know he meant this, and that we were sure of our place among these tried men.

"I do not know anyone who did more in winning our way than Sergeant Robertson. He was everywhere among his men during the heavy shelling. In the early days of morning of June 3rd, when we were retreating, he was one of the men who was not hurrying, and he even came back to help some of the rest along. I have never seen a fellow in the open looking cooler under heavy fire. "It was with this brave spirit, coupled with his great devotion to the men in his charge that he met his death, while encouraging his platoon, under heavy fire from German trench mortars, in the early morning of July 18th.

There are many names on the Honor Roll of McGill University, but the name of Sergeant J. L. A. Robertson should stand among the highest, and his example led many others to play the man, for he was a McGill man who in the greatest meaning of the words lived up to the highest ideals of 'Old McGill'."

Lieut. Maclean, who is reported wounded, enlisted originally with the First Universities Company as a private. He was promoted to the rank of sergeant on account of his splendid ability as a soldier, and of his fine physique. At the spring Training Camp at Niagara-on-the-Lake he made a name for himself as a wrestler. He is the son of Roderick Maclean, Burnaby, B.C. and was born at Valleyfield, P.E.I., on September 18, 1890.

SCIENCE '17 PHOTO.
Mr. Stroud will be on hand Thursday at 1 p.m., to take the Science '17 photo for this year's Annual. In all former years pictures which have been taken there has always been a number of men not included. In order to make this picture complete, it is earnestly requested that all members of the class be present in front of the Engineering Building at one o'clock sharp.

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SPECIAL CONVOCATION TO-MORROW FOR CONFERRING LL.D. UPON H.R.H. DUKE OF DEVONSHIRE, GOVERNOR-GENERAL.

For the purpose of conferring the honorary degree of Doctor of Laws upon His Excellency the Duke of Devonshire, Governor-General of Canada, and Visitor of the University, a special Convocation will be held in the Royal Victoria College to-morrow afternoon at 4.15 o'clock. Students are invited to attend.

The McGill Contingent, Canadian Officers' Training Corps, will attend in a body, the battalion falling in on the old Campus at four o'clock. The evening parade for Thursday has been cancelled.

McGill Daily

THE ONLY COLLEGE DAILY IN CANADA.

The Official Organ of the Undergraduate Body of McGill University

Published Every Day Except Sunday by
THE STUDENTS' COUNCIL.

H. R. Morgan, '17, President, T. J. Kelly, B.A., '17, Editor-in-Chief, J. E. McLeod, '17, Managing Editor.
F. W. Almond, Med. '19, Circulation Manager.

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AFTERMATH.

When a big gun is fired there results quite a bit of noise and smoke, and there is always a recoil. The projectile itself kicks up a lot of dust into the bargain. These two sentences are applicable to the elections held on Monday. The Big Gun has been fired, and the dust and grime and smoke of conflict now hang like a pall over the student life of the University. Some of these students have been accused of using unfair means to secure votes either for themselves or for the men whom they supported. There has been talk, in other years, of similar tactics being employed, but no such definite charges were made as are now brought forward. What does it all amount to? The answer to such a question is somewhat hard to make before the accusations voiced by a representative of the Faculty of Arts are substantiated by the facts which that gentleman has promised to produce. However, a few general ideas on the whole question may not be extraneous to the discussion.

One of the speakers before the Council, at the special meeting on Monday evening, went so far to say that the least solicitation for a vote by a candidate or his supporters was something which should not be tolerated in a University. Some have since said that this is going a little too far. It is true that the most honourable of our men in public life do not hesitate to address the voters, and when it comes to the fine thing this amounts to nothing more or less than a solicitation for their support. It is also true that five minutes' personal conversation with a man will reveal more to the observant listener than will a column of print setting forth a contemplated policy. We have had examples of the latter here at McGill. "Platforms" seem to be, to the men who send them in, mere matters of form and things which can be lightly discarded after election. This has happened in some cases in the past, and we presume (with all due respect to the newly elected men), will happen in the future as long as human nature is human nature. How, then, are we going to bring out the true capabilities of a man running for an office? There are many men in the University, and we don't for a minute imagine that they exist only in our University, who are true weather cocks, for by their attitude you can tell which candidate spoke to them last. But such people will be influenced, no matter what is done to enlighten them as to which is the better man. It is a case of "Heads I win; tails you lose," as far as their votes can be depended upon.

To the average man about college, for we believe that the average college man is intelligent and capable of forming his own opinions, another's personality and character are most clearly revealed by personal conversation. "Hot air" has a motive power, as far as the execution of student interests is concerned, about inversely proportional to the square of its volume. Give a man enough rope, and he will hang himself. However, the danger in this lies in the fact that if even such a latitude is given there will be some who will overstep it, just as in the present case. To us there seem to be but two courses open for its correction.

The more radical is that proposed last Monday, namely that there be absolutely no canvassing; with the penalty, we presume, of expulsion for any student caught doing so. Without any outlet this would make an election very "tame," and we are afraid that it would tend to kill the interest which should be taken in any such important college affair. The other course is a modification of this. Let it be ordered that there be absolutely no personal solicitation for votes, but, if the candidates for office so desire, let there be meetings called either of the various Undergraduate Societies, or of the individual classes, at which meetings the men who are seeking office could address the students, thus giving the student body an opportunity of judging the men who wish to represent them. There are disadvantages to this also. They lie especially in the fact that many a man who would be most conscientious in the execution of his duties is unable to express himself as his more verbose opponent is capable of doing.

If the statements made at the meeting of the Council are proven then it is evident some change must be made. It will be for the Council to decide in what direction that change will be.

ATTENTION, DANCERS.

Cutting a dance is one of the most common of social crimes. It is absolutely unpardonable, and is therefore excusable only upon the presentation of a particularly good alibi.

The Minnesota Daily has drawn up the following list of particularly good alibis which one would do well to remember at the dance on Friday. They are to be given (one at a time) after the cue sentence, "Oh! was this our dance. I'm sorry, but—"

"We couldn't hear the music."

"She couldn't get her pump back on."

"I quite mislaid my programme."

"You two look so much alike I didn't know which I was dancing with."

"He was taking a cinder or something out of my eye."

"I got mixed up—the punch must have gone to my head—what there was of it."

"We thought that was the fourth encore for the last dance."

"I cut it on purpose because I thought it was your sister."

"I saw you waving at me, but I thought you were one of the chaperones."

"Someone ran off with my knitting and I was hunting for it."

"I couldn't come in because the ticket taker was looking for me."

"We didn't know it was so far around the block."

"We thought you'd gone home."

"She got her finger stuck in the davenport and we had to get the janitor."

"We were only just getting a drink."

"We were looking for you everywhere."

"I thought this was ours!"

It has been decided that the inter-collegiate wrestling meet between Columbia, Cornell, Lehigh, Pennsylvania, and Princeton will be held at Cornell next March. The meets are, as a rule, held in rotation at the various colleges in the league. It is Columbia's turn this year to have the intercollegiate, but for some reason the Columbia authorities have waived this right. Hence they have been changed to Cornell, the next in line. Cornell is the present champion, and it should be to her advantage to have this year's intercollegiate held in the home gym. Last year they were held in Princeton.

There has been considerable misunderstanding this fall as to the dates of the intercollegiate meet. These, however, are definitely settled at March 16th and 17th, according to the report of the committee.

A conference for the exponents of vocational education is being held in conjunction with the convention of librarians that is now in session at Ann Arbor, Michigan.

The department of architecture at the University of Illinois has recently made some very interesting additions to its collection of casts. Eight panels of the frieze of the Parthenon, four from the eastern and four from the western frieze and a portion of a full size capital of the same building have arrived and will be hung in the Architectural Library.

Several interesting smaller casts of historic ornament have been added to the collection.

According to a recent report 715 students at Columbia University earned a total of \$155,976 last year.

A FRAGMENT FROM ROSALINE'S "LIFE AND LOVE OF A DREAM GIRL."

"I am the Spirit of Romance before which all the poets and lovers of the world bow down their heads. It is only I, Romance itself, who understands this great mysterious something. It is the pure unfettered soul of mankind. And all those with real souls know me and understand me."

"All men have souls? Perhaps—but many keep them so carefully locked away in a secret corner of their existence that they would be as happy and as wise—soilless."

"Through the eyes of Romance, the favoured see the world,—and life, not as they are, but as they ought to be,—as we would love to have them,—a fairland with every thorn a rose."

"In this fairland, listen! Can you hear the voice that is speaking? A voice, so low, so sweet, that charmed you stop to listen!"

"'Tis Romance, not love," it says, "that makes the world so round."

THE DREAM GIRL.

HOME OFFERED TO UNIVERSITY.
ALBANY, N.Y.—P. Crailo, said to be the oldest house in the United States, has been offered to the University of the State of New York. It stands in Greenbush, a suburb of this city, and from the best information obtainable was built about the year 1659. The house was the fortified home of the Van Rensselaers. It was the birthplace of Catherine Van Rensselaer, the wife of Philip Schuyler, and the mother of the wife of Alexander Hamilton.

The building was constructed of bricks brought over from Holland as ballast. These bear the date of 1639. They are of various shapes and are of a bright terra-cotta color. A stone in the cellar wall bears the date 1642. A tablet marking the house bears this inscription: "General Abercrombie's headquarters while marching to attack Ft. Concordia in 1758, when it is said that at the cantonment east of the house R. Snuckburg composed the popular song of 'Yankee Doodle'."

EDUCATION IN AUSTRALIA.

The subject of education is one in which Australians always show a lively interest, and any proposals that may be for the benefit of pupils in any direction receive a sympathetic hearing from the Government. The Minister for Education in New South Wales, the Hon. Arthur Griffith, recently received a large deputation of representatives of the Council of the Parents' and Citizens' Association of New South Wales on the question of introducing several reforms in the administration of state schools. The deputation was introduced by a member of Parliament, who was supported by some of his colleagues. Amongst the requests put forward for the consideration of the Education Minister were the following:

That the compulsory school age be not raised from 6 to 8 years; that more up-to-date seating accommodation be provided in schools; that all pavilion rooms at schools be made suitable; that in the selection of future sites for schools ample space for playground accommodation be secured; that the interest earned by children's deposits in school banks be made available for use in the schools where earned, for the purpose of restocking libraries and purchasing articles for the benefit of the scholars in their work; that present playgrounds be extended; that lessons on "natural rights" be introduced; that steps be taken for the cultivation of public speaking; that wherever possible, steps be initiated in the direction of insuring that sweets sold to children are pure and wholesome; that in schools where first and second year courses are in operation bursaries obtained by pupils be made tenable for at least two years at such schools, it being pointed out that many parents could not afford to pay for the board of their children at centres away from home; and that the teaching staff be instructed to impress upon children the necessity of economy, particularly with regard to the wasting of food at luncheon and playtime.

JACK LONDON.

The following appreciation of the late Jack London, novelist, is clipped from the Daily Illini, a newspaper published by the students of the University of Illinois:

The hunter has followed his last woodland trail. Never again will the fisherman cast his net into the deep. The author has penned his last line, and beneath the hand of a greater artist has written finish. Jack London is dead. To him, a great adventurer, has come the adventure glorious.

It is hard to realize the fact that there will be no more stories, no more novels pre-arranged by the magic of that well known name. To the readers many novelists are no more than two or three words upon the title pages of their books, but to all Jack London was a personality. That was because he not only wrote, but lived as well. He was admirable in many ways and understandable in all. Even those who choose to read his work for life sometimes long for adventure and romance and envy those who have the spirit and the courage to enter upon the world old quests. In Jack London, fisherman, hunter, longshoreman, fish patrolman, war correspondent, and tramp, the spirit of American adventure found its fullest expression. He lived incarnate. He will have honor among the great soldiers of fortune for all time. Perhaps by no other man has so full a gamut of experiences been run within the short space of forty years.

London was an artist. In literature he was a Columbus; he discovered new worlds. Since he brought forth his best loved stories, most novelists who have written of the north, of its men and its beasts have but rehearsed in inferior fashion what he had done first and well nigh perfectly. There are differences of opinion as to the merits of his style and the value of his subject matter. There can be no question that in his own field and with his own tools he was supreme.

Now that London is dead, the work of his later years will for the most part be forgotten—and it is well. He is not the first artist who has wandered a little from the part of art to follow the gods of gold. He is not the only one who has drifted into an egotistical schism. There comes an age when even adventurers desire peace and worldly goods and the glare of a great success dazzles. But when the later society and sociological novels are forgotten, Jack London will still be remembered for the work of his glorious youth. Generations of

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DR. JONES HAD SOME THRILLERS AT FRONT

McGill Graduate Was at the Battle of the Somme for About Three Weeks.

Dr. H. A. Jones, Med. '00, who gave up his practice at Salisbury, N.B., a year ago, to do his bit in a professional way at the front, reached home last week. The ocean trip was made in fast time. He has had a busy year, and while he has had to work hard he is looking fine and never felt better in his life. Wherever he went in England and France he was splendidly treated, not only by his fellow professional men, soldiers and officers, but by the people in general. Dr. Jones was at the battle of the Somme for about three weeks, and had some close calls, but fortunately escaped without a scratch. He was in one dugout at the Somme when the affair was almost completely demolished by shells; several of his fellow doctors and assistants were killed. He happened at the time to be at the opposite end of the dugout from which his less fortunate comrades were standing. Dr. Jones speaks in the highest terms of the courage and optimism of the boys at the front. He has seen men fatally wounded who would laugh and joke at the time, but we gave it to them all the same; hand me a cigarette."

Dr. Jones will probably return to the front again in the course of a couple of months.

DELTA SIGMA DEBATE.

The second debate of the Delta Sigma Society will take place between the Sophomores and Freshmen in the Common Room of the R. V. C. at 2.30 this afternoon. The proposition to be discussed is: "Resolved, that the Novel has exerted a greater influence than the Play." In this Miss Elmor Forde and Miss Christina Rorke, of the Freshman year will uphold the affirmative side, while Miss Elizabeth Monk and Miss Helen Hague will defend the negative.

The subject is one that is of interest to every student, and therefore a large attendance is expected.

Americans shall read "The Call of the Wild," "The Sea Wolf," and "Tales of the Fish Patrol," and number the author among the world's great tellers of tales.

MAJOR P. BURNETT IS AWARDED THE D. S. O.

Lecturer in Faculty of Medicine Decorated for Service on Somme.

Among the awards of Companionship of the Distinguished Service Order announced yesterday by the War Office is that of Major Philip Burnett, Med. '00, who is second in command of No. 6 Canadian Field Ambulance on the French front. Major Burnett, in the words of the official announcement, "Took over command of stretcher bearers at the front, and within forty-eight hours, carried out numerous duties with great skill and determination though under heavy fire." Major Burnett, who is lecturer in dermatology in the Faculty of Medicine, and dermatologist to the Royal Victoria Hospital, took charge of the organization of No. 6 Field Ambulance here in the spring of 1915, and went overseas as second in command. He has since been with his unit in France, and has been rendering constant useful and gallant service.

Y. W. C. A. PICTURE.
The Y. W. C. A. picture will be taken at 1.45 p.m. to-day.

THE SOCIETE FRANCAISE.
The Societe Francaise will assemble at 11 a.m. at Gordon's Studio, to have its picture taken.

Y. M. BOARD MEETING.
A regular meeting of the Board of Directors of the McGill Y. M. C. A. is called for five o'clock to-day. All members are requested to be present.

Alfred Noyes, visiting professor of English, will return to Princeton in February in time for his second term Senior Course in the 19th century poetry. Professor Noyes for the past few months, has been doing publicity work for the English Government. He has written an article on the English fleet and has made many reports concerning the front in France and Flanders.

HOCKEY PRACTICE.

There will be a hockey practice at the Arena to-day at 5 p.m. The following men are requested to turn out:

Scott, McTague, McCulloch, Slater, Rooney, McGee, Behan, Cully, Beach, Fraser, Anderson, Kelsch, Gibb, Rothschild, Jacques, Robillard, Kelley and Armitage.

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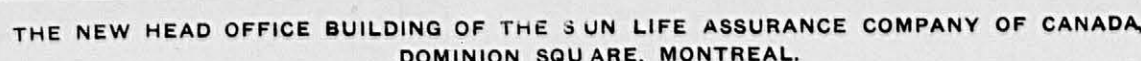


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The annual competitive examination for admission to the college, takes place in May of each year, at the headquarters of the several military districts.

For full particulars regarding this examination and for any other information, application should be made to the Secretary of the Militia Council, Ottawa, Ont., or to the Commandant, Royal Military College, Kingston, Ont.

R. V. C. UNDERGRAD. SOCIETY.
An important meeting of the Undergraduate Society of Royal Victoria College will be held to-morrow, Thursday, December 14, at 1 o'clock. Everyone is expected to attend.

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Use of Gas at the Front

(W. B. CAMPBELL, Sci. '10, in the Journal of Commerce.)

When in April, 1915, the Germans made use of poisonous gas in the second battle of Ypres, the remainder of the world remarked in a shocked horror "what devilish ingenuity these German chemists have!" But as regards mere devilish ingenuity they lag far behind the imaginative writers who concoct the lurid ideas that appear so often in the Sunday editions of some of the metropolitan newspapers. Who has not picked up one of these papers and read of some very plausible sounding scheme whereby the enemy are to be killed off in thousands while our army goes marching on without hurt or hindrance? The average reader devours such articles and revels in the slaughter as he sits by the fire on Sunday morning. The main difference between these inventions and that of our friend Fritz is that Fritz has added knowledge to his imagination, and has had sufficient contempt of the world's opinion to put the thing into practice.

The use of poisonous gases is no new idea. Perhaps the earliest actual use of such thing is, like that of many other inventions, due to the Chinese who many centuries ago used a stink bomb for the confusion of their enemies. So far as we know, however, this was not particularly deadly in its effect, but was calculated to be sufficiently annoying to distract the attention while more potent weapons were being brought into play. In this respect it is somewhat related to the German tear shells, of which more will be said later on. To come down to more recent times there is the story going the rounds of the army regarding a mysterious invention of Lord Dundonald which has been locked up in the tower of London for nearly a hundred years and which would, if only the British Government would consent to use it, completely exterminate the King's enemies. The basis of this story is the fact that away back about seventy years ago it was proposed to use chlorine gas as a weapon of warfare in almost exactly the way that it is now being used. Asphyxiating gases were considered sufficiently possible for the Hague convention to rule against their use some years before this present war. So that German ingenuity is not so extraordinary after all, and their lack of honor which led them to make use of the weapon, led them to have since found out to their cost, it is a game that more than one can play, and the British have added a few improvements to the scheme as well as developing sufficiently adequate means of defence.

"Gas" is used at the front in two distinct ways. The most important and deadly, but not the most frequent is what is known as cloud gas, when it is simply set free in the front trenches and allowed to drift on the wind over the enemy lines. The second way is what is known as shell gas, and as the name implies, it is sent over in the form of shells. It may or may not be poisonous; usually it is not, being simply of an irritant nature causing an irresistible flow of tears from the eyes and rendering men temporarily blind. The irritant effect on the mucous membranes of the throat may be sufficient to cause vomiting, but the effects wear away rather quickly when the victim reaches fresh air.

At first sight it might seem quite a simple matter to make a gas attack, but it is not quite so simple as one is apt to imagine as first thought. First, what gases can be used? The gas must be one which is sufficiently heavy so that it will travel low and not lose itself by diffusion into the higher layers of air—say if it must be at least twice as heavy as air. Then it must be one which is capable of being compressed to a liquid at ordinary temperatures, otherwise it would be impossible to bring sufficient of it up to the front line. When it is compressed it must not be under such a pressure as to make it necessary to use exceptionally heavy cylinders or be overly dangerous to handle; neither must the pressure be too low at ordinary temperatures or the gas will not discharge itself from the cylinders with sufficient rapidity. Last, but not least, it must be sufficiently poisonous so that greatly diluted with air, as it will be, it will still be powerful enough to put men out of action quickly, say, in five minutes. In comparing the poisonous qualities of gases the term Minimum Effective Concentration (written M.E.C.) has been adopted for the least concentration which will knock a man out in five minutes. The term Maximum Bearable Concentration (written M.B.C.) is the greatest concentration which a man can stand for one hour.

Let us now consider some of the gases commonly known as very poisonous and see which of them can be used. Take first Arsenic, AsH₃, it requires 0.10 per cent. for twelve hours to cause death, so that Arsenic is pretty weak. Nickel Carbonyl Ni(CO)₄, is rather poisonous, but it has a boiling point of 40 deg. C., so that it would not discharge itself from a cylinder. It cannot be used in a shell

because it decomposes on detonation. Sulphur Dioxide is a little more than twice as heavy as air, and has a convenient boiling point—10 deg. C. It has a M.E.C. of 0.05 per cent., and M.B.C. of .005 per cent., and should therefore be considered at least a possibility. Nitric Oxide NO₂ has a boiling point of 26 deg. C., and would on that account be difficult to use, although it has a M.E.C. of 0.05 per cent. Hydrogen Sulphide, H₂S, is not quite heavy enough. Its M.E.C. is 0.1 per cent., and its M.B.C. is 0.01 per cent., about half as poisonous as Sulphur Dioxide. Carbon Monoxide is generally supposed to be very poisonous, but is not so deadly as might be supposed. It has a M.E.C. of 0.5 per cent., and a M.B.C. of 0.1 per cent., being only one-fifth as poisonous as hydrogen sulphide. Chlorine is the most effective of the common gases. It has a boiling point of 38 deg. C., so that when liquefied at ordinary temperatures it has a pressure of about six atmospheres, which is quite convenient for the purpose. It is about two and a half times as heavy as air, so will hug the ground pretty closely. It is highly poisonous, M.E.C. being only 0.01 per cent., and M.B.C. being 0.005 per cent. It is also cheap and available in large quantities, so that it is most frequently used by the Germans. Phosgene or carbonyl chloride, COCl₂, is another German favorite. It is about three and a half times as heavy as air and is more poisonous than chlorine, but considerably slower in its action. M.E.C. 0.02 per cent., M.B.C. 0.005 per cent. Even small concentrations such as 0.002 per cent., are liable to cause serious effects on the heart two or three hours after exposure. It has the disadvantage of having a boiling point of 8 deg. C., which is too high to permit of its use alone. By mixing it with chlorine, however, it is possible to use mixtures with about 20 per cent. Phosgene in winter and up to 60 per cent. in summer, and get it all off. These mixtures and straight chlorine are the gases which Fritz has been in the habit of serving up in his cloud gas attacks.

The amount of gas necessary may be somewhat surprising to anyone who has not made any estimates regarding it. Supposing a wind of ten miles an hour and a cloud eight feet high at the enemy trenches, there will be about 22,000 cubic feet of air per minute passing over each yard of trench, which will have to be filled with gas. Aiming at a concentration of one-tenth of one per cent., this will call for about twenty-two cubic feet of pure gas per minute per yard of trench—equivalent in the case of chlorine to about a 1½ pounds per minute per yard. The gas is supplied in cylinders holding about 65 pounds of the liquid, so that to keep up an attack of this intensity under the conditions given would require one cylinder per yard of trench for every 15 minutes' duration of the attack or about 50 tons of gas to the mile front. The cylinders themselves about as much again, so that the requirements of material alone amount to about a ton for each 17 or 18 yards of front. Besides the labor of carrying these heavy and clumsy cylinders up through a mile or two of crooked communication trench on a dark night there is the additional work of preparing emplacements for them, since they must not be exposed to shell fire. When all this is done, and all the co-operation with the artillery and the flanking divisions arranged for, the whole scheme may fall through due to the perversity of the wind which will probably blow the wrong way until too late for the attack to achieve the object desired.

The use of gas in shells presents a different condition. It is not necessary or even advisable to have a substance of too low a boiling point since the bursting charge of the shell will break up a liquid into such fine particles that even fairly high boiling materials are sufficiently vaporized. On the other hand some of the otherwise suitable substances cannot be used, since they are decomposed by the detonation when the shell explodes. Prussic acid, with a boiling point of 26 deg. C., is one of these. It is about three times as poisonous as chlorine. Moreover, it is very difficult to obtain sufficient concentration of a poisonous gas and maintain that concentration long enough for it to be effective. The gas shells used by the Germans are the 150 millimeter howitzer size, and have a capacity of 2,350 cubic centimeters. This amount of the liquid is spread by the explosion through the surrounding air to a distance of about ten yards in every direction from the shell or into 50,000 cubic feet. The greater part of this is immediately shifted by the wind, and unless exceedingly heavy bombardment is maintained on the one area the concentration of poisonous material is too small to be dangerous. In consequence shells are not much depended upon for actual toxic effects. By loading them with some substance like Xylol Bromide, C₈H₉Br, which has a high boiling point—about 193 deg. C.—a large part of it is driven into the ground when the shell bursts, and it takes several days for it to evaporate. This Xylol Bromide is extremely irritating to the eyes, one part of it in two hundred thousand parts of air being unbearable without protection. It is, however, not permanently injurious. These "tear shells," then, though not deadly, are capable of causing a great deal of annoyance at critical moments, especially when used against artillery who have to maintain their position. In at least one case a battery has been compelled to shift simply on account of these tear shells, although no one had been hit. The shell holes generally have sufficient of the Xylol Bromide in them to be uncomfortable for about three or four days. In the case of the battery just mentioned, about two hundred and seventy shells were plans in the vicinity in about half an hour or so. Another substance used by the Germans in shells is chloromethyl chloroformate. This has the tear producing effect of the Xylol Bromide, though in a less degree, and it also has the poisonous effect of phosgene from which it is made. This shell is not particularly effective, as neither its poisonous nor its irritating properties are sufficiently great. In one case a small wood in which there were many Canadians was fairly heavily bombarded by these shortly after they

came into use, but aside the peculiar smell no one noticed any particular effects.

The first gas attack of the war was made in April, 1915, at the second battle of Ypres. It was directed mostly toward the French troops, who were on the left of the Canadians, but there was enough on the Canadian front to cause heavy casualties. On the French front it was terribly successful, making a clean sweep over a front of over two miles. No one had any protection, and the only survivors were those who buried their faces in the earth or were able to get up high enough to be above the cloud. Evidently the immense effect had not been anticipated by the German General Staff, since they did not take full advantage of the gap they had opened up, although some small parties of Germans wandered so far forward that they got lost and were later made prisoners. The main German force did not advance until the third Canadian Brigade, assisted by a battalion of Durhams just newly arrived from England, had extended their line about three thousand yards, and although this did not fill the whole gap sufficient resistance was made to hold back the German forces until reorganization of the defence had been effected.

At this first battle the British and French troops had no protection whatever against the gas, but immediately on word of it reaching England work was started on respirators. Over a million were made in three days by the women of the Old Country. The first forms were very crude and inefficient, being simply a pad of absorbent cotton, like a small pin-cushion head. The pad was soaked in a solution of sodium carbonate and placed over the nose and mouth, but unfortunately it was too tight to allow much air to filter through, and it came instead around the edges and so avoided purification by the soda. The next kind were similar, but an improvement, consisting of a larger pad of many layers of absorbent gauze, soaked in a solution of Hypo, soda carbonate and glycerin. These were used at the Hill 60 battle, and in some cases were quite effective, while in others they failed entirely owing to being put on improperly. About this time the "Smoke Helmet" came into being. This was simply a flannel bag with a window of cellulose acetate stitched in. The flannel was soaked in the soda-hypo mixture and breathing was done through the cloth both in and out, the chlorine being removed in passage. When this helmet was being worn the bottom was tucked under the tunic so as to make a tight joint and the head was completely enclosed. Foul air from the lungs accumulated to some extent inside the helmet, but this was not found to be as detrimental in practice as some doctors anticipated. It did, however, make the helmet uncomfortable to wear for any length of time, but the main point was that it efficiently stopped chlorine. This was in use until the latter part of August, 1915.

About this time, or slightly before, the secret service brought word that the Germans were preparing to use Phosgene, against which the "Smoke Helmet" was slight protection. To meet this temporarily and to improve the protection against chlorine a new helmet was brought out, known as the "P" helmet. This kept to the use of the bag form, but with several important changes. The material was changed from flannel to flannelette of a special weave and two thicknesses were used in place of one. The eyepieces were made of glass in metal frames, in place of the cellulose acetate which was very liable to damage. A mouthpiece was put in with a valve, so that the foul breath could be breathed out of the helmet and only fresh air gain entrance.

The chemical protection was radically changed; owing to the use of a cotton fabric in place of wool it was possible to use caustic soda, and with this was used phenol. The soda was used in sufficient quantity to be equivalent to the phenol and leave about 10 per cent. excess. Glycerin was added to keep the whole moist. This helmet gave very efficient protection against chlorine, and was so easy to wear that it was used in practice work for an hour or more at a time without discomfort. In one attack it successfully withstood gas for over four hours. It also provided some protection against the phosgene—sufficient at least to combat any concentration which might be put over during the cold weather. This was abundantly shown when the Germans made an attack of record intensity and duration just north of Ypres on December 15, 1915.

(To be Concluded.)

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